NOBLE GAS ISOTOPIC ABUNDANCES IN ACAPULCOITES AND LODRANITES ACAPULCO, ALH 81187, ALH 81261, ALH 84190, LEW 86220, LEW 88280, AND QUE 93148. A. Weigel [1,2], S. Neumann [3], O. Eugster [1], R. Michel [3], [1] *Physikalisches Institut, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland*, [2] *present address: University of California San Diego, Dept. of Chemistry 0317, La Jolla CA 92093, U.S.A.*, [3] *Center for Radiation Protection and Radioecology, University of Hannover, D-30167 Hannover, Germany*.

We continue our comprehensive studies of the cosmic ray exposure history of acapulcoites and lodranites [1] to include new noble gas data of acapulcoites (Acapulco, ALH 81187, ALH 81261, ALH 84190), of lodranites (LEW 88280 and QUE 93148), and of the transitional acapulcoite/lodranite (LEW 86220)(Table 1). Calculations using the HERMES high-energy transport code [2] were performed in order to understand the interactions of galactic and solar cosmic rays with these meteorites. The model calculations are based on the same excitation functions of p- and n-induced reactions as used in recent calculations [3].

Acapulcoites and lodranites are primitive achondrites that experienced temperatures of ∼980-1250°C leading to partial melting and differentiation. Based on oxygen isotopes it was suggested that these meteorites come from a common parent body with roughly chondritic chemical composition [4]. All acapulcoites and lodranites except QUE 93148 (13.1 Ma) have cosmic-ray exposure ages of ∼6 Ma. This may indicate that a single event led to ejection from their parent body [1] (Table 2).

Contents of trapped He, Ne, and Ar in acapulcoites and lodranites are very low. This allows us to evaluate reliable cosmogenic noble gas isotopic abundances (Table 2). By remeasuring a bulk of LEW 88280 and the silicate fraction of QUE 93148 we found that our previously reported noble gas isotopic abundances for both samples were to low (by up to 60% of ^{4}He, 47% of ^{20}Ne, and 82% of ^{40}Ar) due to incomplete degassing.

All acapulcoites and lodranites have quite high cosmogenic ^{22}Ne/^{21}Ne ratios indicative for relatively low shielding. Results of the measured ratios (^{3}He/^{21}Ne and ^{22}Ne/^{21}Ne) and activities (^{26}Al and ^{10}Be) were compared to results of the simulation. The discrepancy between both data sets indicates that effects of bulk chemistry and solar cosmic ray produced nuclides cannot fully explain the shielding conditions of the meteorites Y 74063, EET-84302, LEW 88280, Lodran, and Y 791491 [1]. However, increasing the metal to silicate ratio results in higher galactic cosmic ray induced ^{3}He production rates. To match simulated and measured ^{3}He/^{21}Ne and ^{22}Ne/^{21}Ne ratios in the Lodran meteorite up to 50% metal must have been present. Indeed, metal to silicate ratios in lodranites are variable [5]. Chalcophile and siderophile element ratios (Se/Co, Ir/Ni) indicate loss or gain of a low temperature S-rich metal melt in some lodranites and acapulcoites [5, and J. Zipfel pers. commun.].

Whether the discrepancy between the measured and simulated shielding conditions is a calculational artifact or whether Lodran experienced a complex exposure history still needs to be explored.

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NOBLE GAS ISOTOPIC ABUNDANCES IN ACAPULCOITES AND LODRANITES: A. Weigel et al.

Table 1: He, Ne, and Ar concentrations and isotopic ratios of acapulcoites and lodranites.

	Weight	^{4}He	^{20}Ne	^{40}Ar	$\frac{^{4}He}{^{3}He}$	$\frac{^{20}Ne}{^{22}Ne}$	$\frac{^{22}Ne}{^{21}Ne}$	$\frac{^{40}Ar}{^{36}Ar}$	$\frac{^{36}Ar}{^{38}Ar}$
	mg	10^{-8}cm^{3}STP/g							
ALH81187	20.55	1089 ±43	1.38 ±0.06	1682 ±39	116.4 ±2.3	0.902 ±0.020	1.367 ±0.057	370.8 ±4.6	4.51 ±0.04
ALH81261	22.32	2173 ±87	0.98 ±0.04	4967 ±132	296.0 ±5.0	0.931 ±0.028	1.306 ±0.031	772.1 ±12.6	4.78 ±0.12
ALH84190	21.02	1000 ±39	1.52 ±0.05	1421 ±33	105.0 ±1.3	0.943 ±0.015	1.346 ±0.025	358.9 ±4.9	4.31 ±0.06
Acapulco	21.27	16198 ±522	1.54 ±0.07	3400 ±86	1506.6 ±19.0	0.832 ±0.023	1.184 ±0.014	635.4 ±29.0	4.22 ±0.06
LEW86220	21.86	216 ±8	1.15 ±0.06	3514 ±89	30.37 ±0.48	0.814 ±0.048	1.285 ±0.029	3400. ±371.	3.54 ±0.30
LEW88280	20.43	116 ±4	1.13 ±0.04	72 ±3	12.53 ±0.33	0.912 ±0.029	1.231 ±0.028	9.38 ±0.37	4.38 ±0.08
QUE93148 Fe/Ni	19.95	56 ±2	0.48 ±0.02	46 ±10	3.11 ±0.03	0.894 ±0.035	1.065 ±0.041	45.53 ±8.60	0.76 ±0.03
QUE93148 Silicate	28.00	138 ±4	6.00 ±0.19	288 ±10	4.64 ±0.06	0.834 ±0.014	1.102 ±0.014	304.0 ±14.6	2.78 ±0.21
QUE93148	bulk[1]	102 ±2	3.57 ±0.11	181 ±7	4.15 ±0.04	0.840 ±0.017	1.097 ±0.020	185.6 ±15.9	1.26 ±0.12

Weighted errors represent 2σ level. [1] Calculated values for bulk material adopting 44% Fe/Ni and 56% silicates.

Table 2: Trapped, radiogenic, and cosmogenic He, Ne, Ar, and cosmic ray exposure ages of acapulcoites and lodranites.

	$^{20}Ne_t$	$^{36}Ar_t$	$^{4}He_r$	$^{40}Ar_r$	$^{3}He_c$	$^{21}Ne_c$	$^{38}Ar_c$	$\left(\frac{^{22}Ne}{^{21}Ne}\right)_c$	T_3	T_{21}	T_{38}^{*}
	10^{-8}cm^{3}STP/g								Ma		
ALH81187	0.17 ±0.03	4.42 ±0.12	1040 ±043	1682 ±39	9.36 ±0.41	1.12 ±0.07	0.17 ±0.01	1.349 ±0.056	5.3	4.9	3.7
ALH81261	0.15 ±0.03	6.33 ±0.20	2135 ±87	4967 ±132	7.34 ±0.32	0.80 ±0.05	0.16 ±0.04	1.284 ±0.031	4.5	3.7	2.9
ALH84190	0.25 ±0.02	3.83 ±0.10	951 ±39	1421 ±33	9.53 ±0.39	1.19 ±0.05	0.20 ±0.02	1.322 ±0.025	5.6	5.4	3.6
Acapulco	0.07 ±0.05	5.16 ±0.27	16142 ±522	3400 ±86	10.75 ±0.37	1.56 ±0.08	0.30 ±0.02	1.179 ±0.014	6.7	6.6	5.5
LEW86220	$<$ 0.09	0.96 ±0.11	179 ±8	3514 ±89	7.12 ±0.26	1.10 ±0.09	0.11 ±0.03	1.283 ±0.030	∼4.4	∼3.7	∼4.2
LEW88280	0.15 ±0.03	7.48 ±0.42	68 ±5	72 ±3	9.23 ±0.32	1.01 ±0.05	0.36 ±0.04	1.214 ±0.028	6.3	5.9	7.0
QUE93148	0.19 ±0.03	0.54 ±0.04	0	181 ±7	24.58 ±0.66	3.87 ±0.13	0.68 ±0.16	1.091 ±0.020	∼15.5	∼9.0	∼14.5

Weighted errors represent 2σ level. * according to [6].